Lithium Fuel Cells. 50:50 MEEP-PhO Swelling Effect of Polyphosphazene Membranes for Primary Aqueous Lithium Battery Systems

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This paper presents results obtained on the swelling with time of the MEEP/ PhO membrane (lithium-metal/membrane/sea-water/cathode system) when the polymer is in contact with the water. The membrane is used as a substitute of the natural bilayer formed when lithium is in contact with water. The objective of the membrane is to increase the anodic efficiency of the lithium/water system. We have extensively studied the lithium—water system finding that lithium in alkaline electrolytes forms a double passive layer (LiH and LiOH) at the interface. LiH is a compact, thin inner layer formed on the surface of the lithium-metal (of the order of Angstroms). LiOH is formed as a re- precipitated outer thick porous layer over the LiH layer (microns); the outer layer regulates the lithium metal dissolution. The LiOH outer layer thickness depends on the equilibrium between the formation of the LiOH at the LiH — LiOH interface and the dissolution of LiOH in the electrolyte. This outer layer can completely passivate the lithium if it becomes thick enough to prevent water from reaching the LiH interface. This passivation occurs in high pH electrolytes. On the other hand, if the pH is lowered (¿ 6-12) or the LiOH layer is mechanically destroyed, a violent reaction between the lithium and the water at the anode is maintained. An approach to make the lithium/water reactions manageable is to cover the lithium surface with a polymer, which will be designed to conduct lithium ions without letting the water to become in contact with the lithium surface.